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TITLE: Natural History of Multi-Drug Resistant Organisms in a New Military Medical Facility

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CONTRACTING ORGANIZATION: The Geneva Foundation
Tacoma, WA 98402

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13. SUPPLEMENTARY NOTES

14. ABSTRACT

The overarching goal of this multi-year study is to utilize a rare opportunity to study the origins and evolution of environmental contamination with five multidrug-resistant organisms (MDRO) and Clostridium difficile de-novo on an 'epidemiologic clean slate' before the opening of Walter Reed National Military Medical Center (WRNMMC), Bethesda, MD, and DeWitt Army Community Hospital (DACH), Ft Belvoir, VA. Both are projected to open September 2011. Secondly, it is to compare the trajectory of contamination at WRNMMC, which is based on conventional construction methods, to analogous areas in DACH-a facility constructed using evidence-based design optimized for patient safety, including infection prevention and control.

15. SUBJECT TERMS
Multi-Drug Resistant Organisms, infection, treatment facility

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INTRODUCTION:

The overarching goal of the proposed study is to utilize a rare opportunity to study the origins and evolution of environmental contamination with five multidrug-resistant organisms (MDRO) and *Clostridium difficile de-novo* on an 'epidemiologic clean slate' before the opening of Walter Reed National Military Medical Center (WRNMMC), Bethesda, MD, and DeWitt Army Community Hospital (DACH), Ft Belvoir, VA. Both are projected to open September 2011. Secondly, it is to compare the trajectory of contamination at WRNMMC, which is based on conventional construction methods, to analogous areas in DACH- a facility constructed using evidence-based design optimized for patient safety, including infection prevention and control.

BODY:

This is a multi-year study, the majority of the work will occur immediately prior to and after the opening of the new facilities in September 2011. However, several important milestones have been met and are linked to the statement of work below.

AIM 1: Months 1-12. Determine the sampling locations that result in the greatest number of MDRO at an existing (preferably nascent) military facility.
Status: 100% completed.

Task 1 A: Months 1-3. Create a relational database to be populated with clinical, environmental, geographical, phenotypic and genotypic information along with a digital floor plan and map of the new facilities in Bethesda, MD and Ft Belvoir, VA.
The database is complete, but due to concerns about the release of sensitive, potentially classified, information (floor plans of military facilities) it has been difficult to obtain CADs and schematics of the new facilities. So the digital floor plans have not been obtained yet, but partial ones are forthcoming.
Status: 100% completed.

Task 1B: Months 3-10. Using rayon swabs in the bacterial transport media validated in the Iraq study, quantitatively collect samples from various surfaces throughout the old WRAMC, Washington, DC, including patient care areas such as the ICU, operating suite, procedure units, and inpatient wards and common areas such as patient lounges and hallways. Perform: 1) standard cultures for identification and susceptibility testing of nosocomial pathogens, and 2) PCR to identify specific target sequences.
the required protocol for Research Not Involving Human Subjects was submitted and is pending IRB approvals. More surveillance is required. A limited, informal survey of high-risk areas in WRAMC was completed. No MDRO were isolated. A larger more formal surveillance will be conducted immediately after the IRB approval of the protocol.
Status: 100% completed

Task 1C: Months 10-12. Define and validate the best molecular methods to be employed prospectively at WRNMMC: (1) choose the most relevant gene targets for real-time PCR surveillance of the new hospital, (2) submit a limited number of samples to a commercial pyrosequencing company to validate the suitability of our sample collection for the future application of this technology; refine sample collection and/or DNA extraction methods as required.

This summer we developed a proof of concept PCR assay for six pathogens using a Roche LightCycler 480. The six organisms were *A. baumannii*, *C. difficile*, *E. coli* ESBL, *K. pneumoniae*, *P. aeruginosa*, and MRSA. We generated primers from genes large enough to have species specific regions (eg, *ompA* or *gyrA*) or were species specific themselves (eg, *algD*). 16S universal primers were also included in the assay for total bacterial load. The primers were tested for efficacy and specificity; standard curves were also generated to allow for DNA quantification.

After the primers were tested, they were organized onto a 96-well plate allowing for all six samples to be screened at once. Once the assay was developed, a preliminary swabbing method was tested. Initial data suggests the PCR limit of detection from bench top swabbing to PCR is 10^5-10^6 organisms. Further optimization may yield 10-100 fold improvement in detection, but some signal loss is inevitable due to the steps involved in extracting PCR quality DNA from environmental samples. The assay only had a few developmental problems and they were related to the swabbing, not the PCR sensitivity. We found there was about a four-log yield loss between the target surface to final sample DNA. We may be able to reduce this to three or less log loss but there will always be template lost. We did not have the time this summer to optimize this. The second problem was the time needed to process each sample.

The swabbing, extracting, and PCR analysis of each sample takes time which is compounded by the limited number of samples you can fit onto a 96-well plate (1) or a 384-well plate (5) for a PCR run. Primer selection and verification was relatively straightforward. Dr. Zurawski, Dr. McGann, and Mitchell Thompson were instrumental in target selection. If some primer targets were not as efficient or widely present in a species, it was not difficult to find replacement targets. Melting curve analysis also helped to verify that the correct targets were amplified. It was also not difficult to acquire reference strains. Only C. difficile proved a challenge because it needed special culture conditions (anaerobe).

During the initial testing of the E.coli primers, we found that the primers worked well for some strains, but poorly for others. After doing a BLAST alignment, we found that the primers sat on a region of DNA that contained mismatches between species, hence the poor performance (ie higher CT values) with some strains. With this in mind, we designed new primers around regions of 100% homology, and solved the problem.
In an attempt to better assess specificity, Dr McGann acquired 30 isolates spanning 30 different species isolated at WRAMC. Our plan is to extract the DNA from these and do further specificity tests. Pending approval to use WRAMC's anaerobic incubation chamber, we plan on testing the C. difficile primers. Finally, each primer set will be tested against 10 members of the target species (e.g. 1 different strains of A. baumannii), to examine the correlation between melting curve Tm Ideally they should be very similar, but using an R-squared correlation (Independent variable = Strain; Dependent=Tm of amplicon) we hope to quantify the relationship. This would add a lot of strength to any paper. **Status: 100% completed**

AIM 2: Month 13 or 1 month prior to opening. Determine baseline level of MDRO contamination in the new facility (WRMMC, Bethesda, MD) using methods optimized above. **Task 2A: Month 13.** Repeat steps in Task 1B above, beginning collection at least one month prior to arrival of patients and providers. **Status: 100% completed**

Task 2B: Month 13. After isolating the MDRO in 1B , perform molecular genotyping to assign a unique 'fingerprint' to each MDRO isolate. This fingerprint will allow us to track the occurrence of that strain throughout the hospital and link it to a specific source. Strain-level genotyping will be performed using pulsed-field gel electrophoresis (PFGE) onspecies isolates from this study. **Status: Ongoing 10% completed**

AIM 3: Months 14-22. Prospectively survey WRMMC to document the establishment of MDRO reservoirs and pattern of spread th roughout the facility. Repeat quantitative collections at intervals determined above. **Status: Ongoing 10% completed**

KEY RESEARCH ACCOMPLISHMENTS: Bulleted lis t of key research accomplishments emanating from this research.

- Final IRB protocol approved
- A novel real-time PCR assay for the detection of nosocomial pathogenic bacteria was developed and validated in the hospital setting
- Key collaborations with nati onal authorities were establis hed and this resulted in an intervention being added (staff education) and also an overall enhancement of the sampling plan and study design using CDC approved cleaning protocol
- MOA/MOUs were established w/ Sandi a National Laboratory and with Clinical Research Management
- Results from environmental surveillance of a nascent facility were published
- We began surveillance before any patient s or healthcare workers entered the new hospital in Virginia, or new wings of the hospital in Maryland
- We demonstrated (unfortunately) that time and money cannot be saved by using a composite swab for all surfaces for the RT-PCR assay. A separate swab must be collected and processed for each surface. This means we have to continue to collect process 17 additional swabs for each room.

REPORTABLE OUTCOMES:

- Developed integrated, labor-saving processing system for cataloging and archiving samples using BROOM software (Building Remediation Optimization and Outcome Modeling).

- Developed and validated species-specific, real-time PCR assay for the five of the six ESKAPE pathogens and C. difficile.

- Implemented a CDC-approved protocol for assessing the thoroughness of room cleaning for 17 high-touch surfaces using an invisible dye-marking system (Dazo and Encompass Monitoring System) at two hospitals before opening. Baseline data collection using this system indicated that some high-touch surfaces were never cleaned (i.e. light switches) and others were consistently cleaned (toilet seats) – see attached report.
- This grant provided employment for 1 research assistant for 2 years at 100% effort, two students at 100% effort during vacation periods, 1 BS technologist for 2 years at 10% and 1 PhD at 10% effort for 2 years and travel for one of the students to the annual meeting of the ASM.

CONCLUSION:

Surveillance is ongoing as the hospitals just opened last month Sept 2011 so it is too early to data analysis and conclusion.

All twelve primer pairs were capable of detecting 10-50 gene copies with a high degree of specificity from pure bacterial cultures . The procedure was also capable of detecting bacterial contamination of clinical and laboratory work surfaces from pre-moistened swabs, comparable to results obtained from culture-based techniques. Subsequent analysis of the melting curves provided accurate identification of the contaminating species, both from control and test swabs.

The RT-PCR assay described herein can serve as an important tool for infection control practitioners' ability to detect the six common bacterial species that contribute to clinical infection. The assay is well suited for both basic research and clinical laboratories and is currently being used in a large-scale clinical surveillance protocol.

Most notable is the excellent concordance we are observing with the 16s assay, the culture results and the species specific RT-PCR. We are in the process of adding the cleaning data.

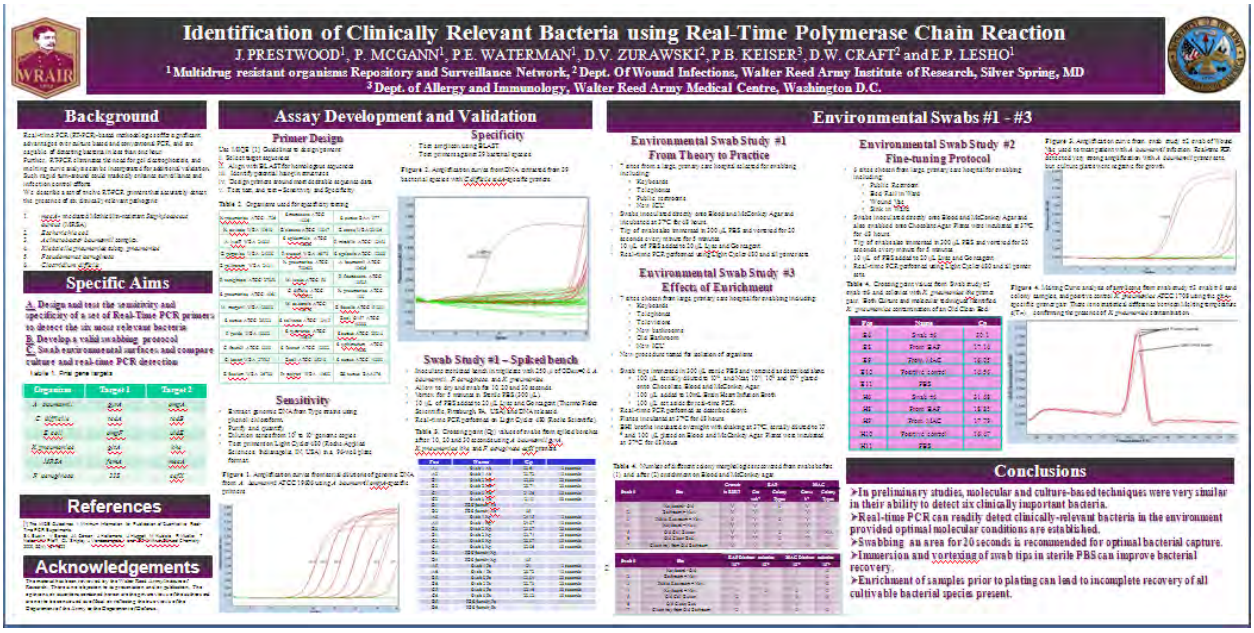
This remains an exciting, successful and unprecedented effort.

REFERENCES:

Ake J, Scott P, Wortmann G, Huang XZ, Barber M, Wang Z, Nikolich M, Van Echo D, Weintrob A, **Lesho E**. Gram-negative multidrug-resistant organism colonization in a U.S. military healthcare facility in Iraq. *Infection Control and Hospital Epidemiology*. 2011;32:545-52.

Lesho E, Ake J, Huang X, Cash DM, Nikolich M, Barber M, Robens K, Garnett E, Lindler L, Scott. Amount of usage and involvement in explosions were not associated with increased contamination of pre-hospital vehicles with multidrug-resistant organisms. *Prehospital and Disaster Medicine*. At press.

SUPPORTING DATA:



APPENDICES: There are 4 attachments.

Appendix 1 = Combination of culture and molecular results
Appendix 2 = Thoroughness of cleaning results at WRNMMC
Appendix 3= Thoroughness of cleaning at Belvoir
Appendix 4 = Composite cleaning report.

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ENCOMPASS™ Environmental Hygiene Program

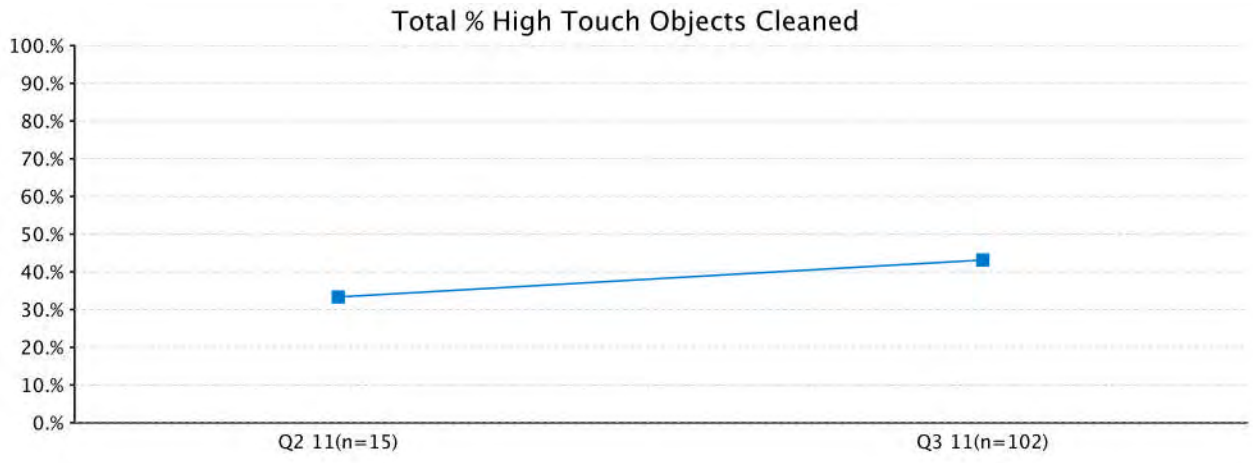
Walter Reed National Naval Medical Center

EnCompass™ Environmental Hygiene Results

ECOLAB

Report Run by User: wrnmc38

Total % High Touch Objects



Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

ECOLAB

Report Run by User: wrnmc38

Focus Areas Report

Top 3 HTOs	% Cleaned
Toilet Flush Handle	88 %
Bathroom Handrail by Toilet	75 %
Bathroom Sink	71 %

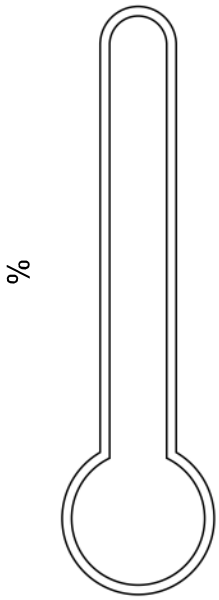
Bottom 3 HTOs	% Cleaned
Bathroom Light Switch	0 %
Room Sink	0 %
Room Light Switch	0 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

ECOLAB

Report Run by User: wrnmc38

Progress Against CDC Recommended Quarterly Sampling Current Quarter -- 03



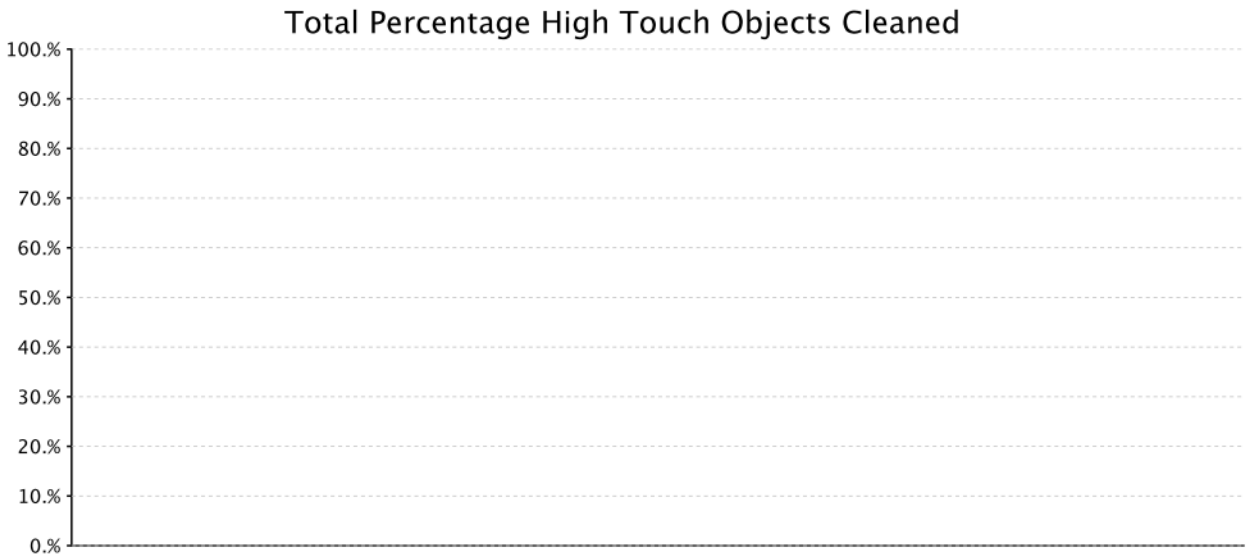
CDC Recommendation:	
Audits Completed:	7 rooms

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

ECOLAB

Report Run by User: wrnmc38

Patient Area Report

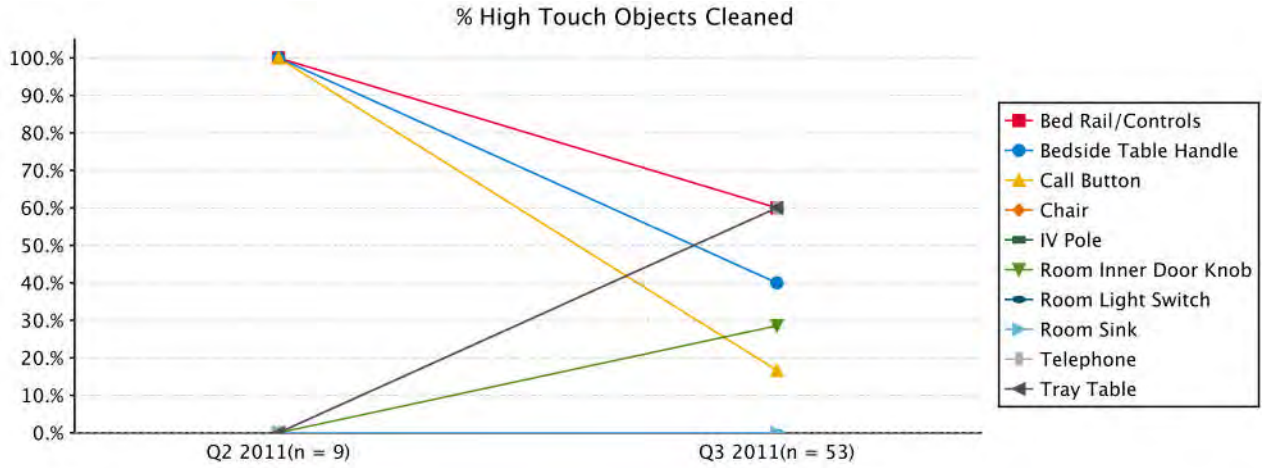


Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

ECOLAB

Report Run by User: wrnmc38

High Touch Object

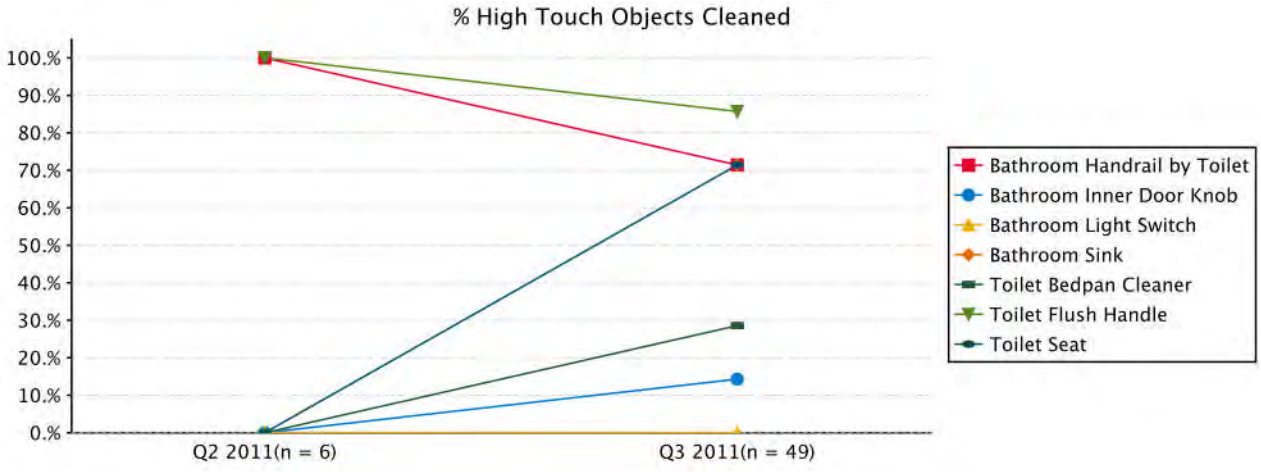


Quarter	Bed Rail/Contr	Bedside Table	Call Button	Chair	IV Pole	Room Inner Door	Room Light Switch	Room Sink	Telephone	Tray Table
Q2 2011	100 %	100 %	100 %	0 %		0 %	0 %	0 %	0 %	0 %
Q3 2011	60 %	40 %	17 %	60 %	60 %	29 %	0 %	0 %	60 %	60 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

ECOLAB

Report Run by User: wrnmc38



Quarter	Bathroom Handrail	Bathroom Inner Door	Bathroom Light	Bathroom Sink	Toilet Bedpan	Toilet Flush	Toilet Seat
Q2 2011	100 %	0 %	0 %		0 %	100 %	0 %
Q3 2011	71 %	14 %	0 %	71 %	29 %	86 %	71 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

ECOLAB

Report Run by User: wrnmc38

Percent High Touch Object Cleaned

High Touch Objects	Baseline	Q2 2011	Q3 2011	Net Improvement (Over Baseline)	Trend (Over Last Period)
Bed Rail/Controls		100 %	60 %	60 %	Down
Bedside Table Handle		100 %	40 %	40 %	Down
Call Button		100 %	17 %	17 %	Down
Chair		0 %	60 %	60 %	Up
IV Pole			60 %	60 %	Up
Room Inner Door Knob		0 %	29 %	29 %	Up
Room Light Switch		0 %	0 %	0 %	No Change
Room Sink		0 %	0 %	0 %	No Change
Telephone		0 %	60 %	60 %	Up
Tray Table		0 %	60 %	60 %	Up
Bathroom Handrail by Toilet		100 %	71 %	71 %	Down
Bathroom Inner Door Knob		0 %	14 %	14 %	Up
Bathroom Light Switch		0 %	0 %	0 %	No Change
Bathroom Sink			71 %	71 %	Up
Toilet Bedpan Cleaner		0 %	29 %	29 %	Up
Toilet Flush Handle		100 %	86 %	86 %	Down
Toilet Seat		0 %	71 %	71 %	Up
Total Patient Bathroom		33 %	49 %	49 %	Up
Total Patient Room		33 %	38 %	38 %	Up
Grand Total		33 %	43 %	43 %	Up
n=(# of objects evaluated)		15	102		

	< 70%
	70% - 80%
	> 80%

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

ECOLAB

Report Run by User: wrnmc38

Room Level Results

Date	Time	Unit	Room Number	EVS Tech	Patient Room	Bathroom	Overall
05/12/2011	10:39:18 (EDT)		13 medical	eve	33 %	33 %	33 %
07/08/2011	10:53:38 (EDT)		11 hemonc	Eve	25 %	71 %	55 %
07/08/2011	11:19:24 (EDT)		13 Hemonc	Eve	56 %	71 %	62 %
07/29/2011	10:13:56 (EDT)		ccu 450	eve	40 %	14 %	29 %
07/29/2011	10:24:19 (EDT)		hemonc 06	eve	62 %	57 %	60 %
08/24/2011	14:34:49 (EDT)		5c13mw	eve	44 %	57 %	50 %
08/24/2011	13:56:05 (EDT)		5e03sw	eve	0 %	57 %	40 %
08/25/2011	14:13:38 (EDT)		445 sw	eve	10 %	14 %	12 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-09-23 Isolation Rooms?:All

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ENCOMPASS™ Environmental Hygiene Program

BASELINE

Walter Reed National Navel Medical Center

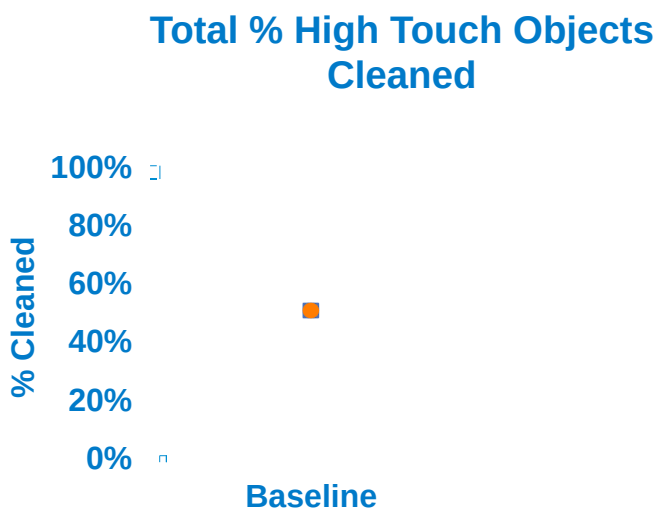
EnCompass™ Environmental Hygiene Results

ECOLAB®

WRNNMC
Baseline Results

Thoroughness of Disinfection Cleaning

High Touch Objects



Focus Areas

Top 3 HTO's	% Cleaned
Bed Rail/Controls	100%
Bedside Table Handle	100%
Bathroom Handrail by Toilet	100%

Bottom 3 HTO's	% Cleaned
Room Inner Door Knob	0%
Bathroom Light Switch	0%
Room Light Switch	0%

ECOLAB®

Heat Map

Progress and Trend Report

80 -100%
70 - 79%
<70%

Percent of High Touch Objects Cleaned

N = 42

Current Period n = 42

	High Touch Object	Baseline	Q3 2011	Q4 2011	Net Improvement	Trend
Patient Room	Bed Rail/Controls	100%				
	Bedside Table Handle	100%				
	Call Button	50%				
	Chair	67%				
	IV Pole (Grab Area)	0%				
	Room Inner Door Knob	0%				
	Room Light Switch	0%				
	Room Sink	0%				
	Telephone	33%				
	Tray Table	50%				
Patient Bathroom	Bathroom Handrail by Toilet	100%				
	Bathroom Inner Door Knob	33%				
	Bathroom Light Switch	0%				
	Bathroom Sink	50%				
	Toilet Bedpan Cleaner	67%				
	Toilet Flush Handle	100%				
	Toilet Seat	67%				
	Total Patient Room	41%				
	Total Patient Bathroom	60%				
	Grand Total	50%				

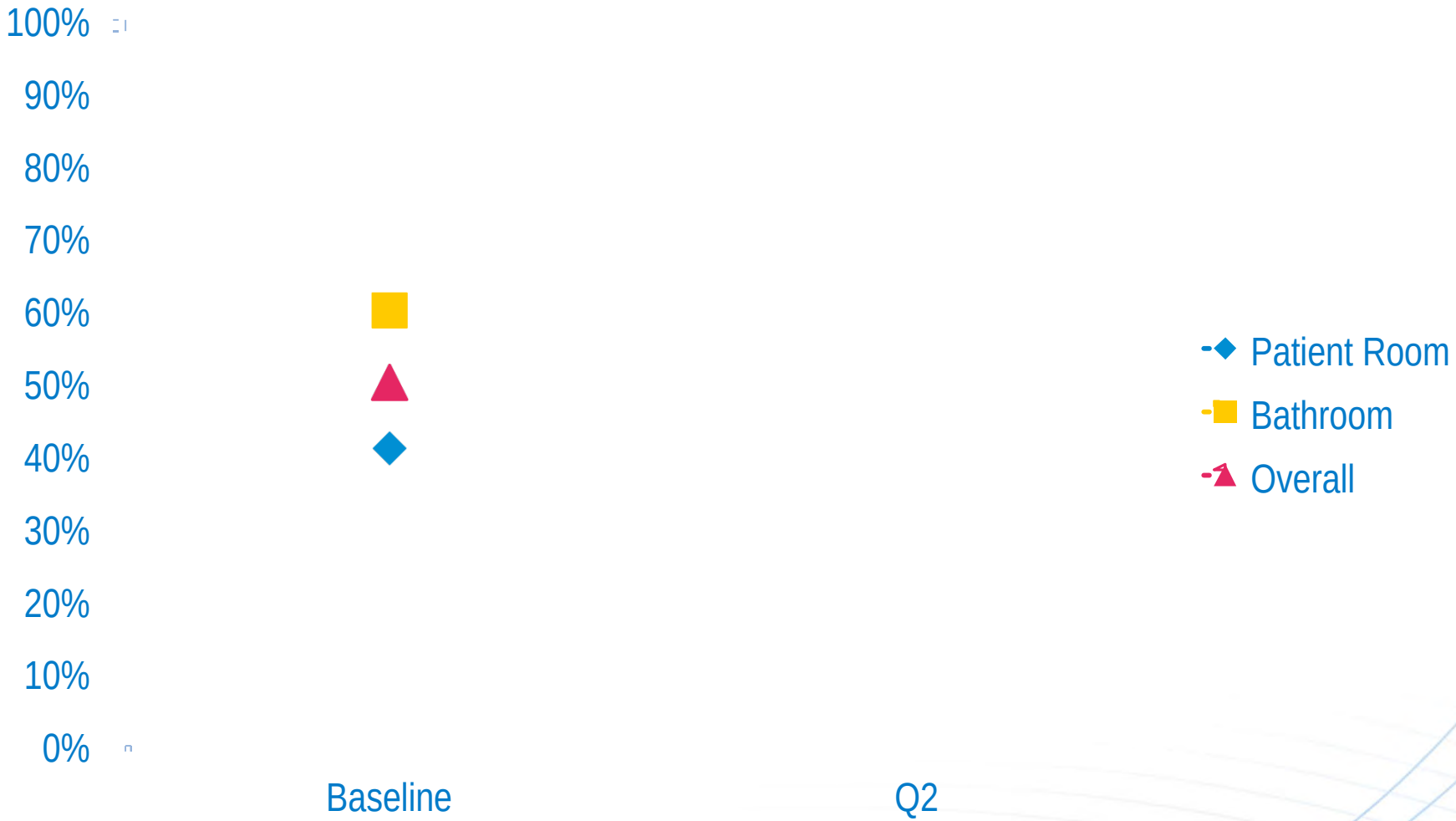
ECOLAB

Patient Area

Total % High Touch Objects Cleaned

N = 42

Current Period n = 42



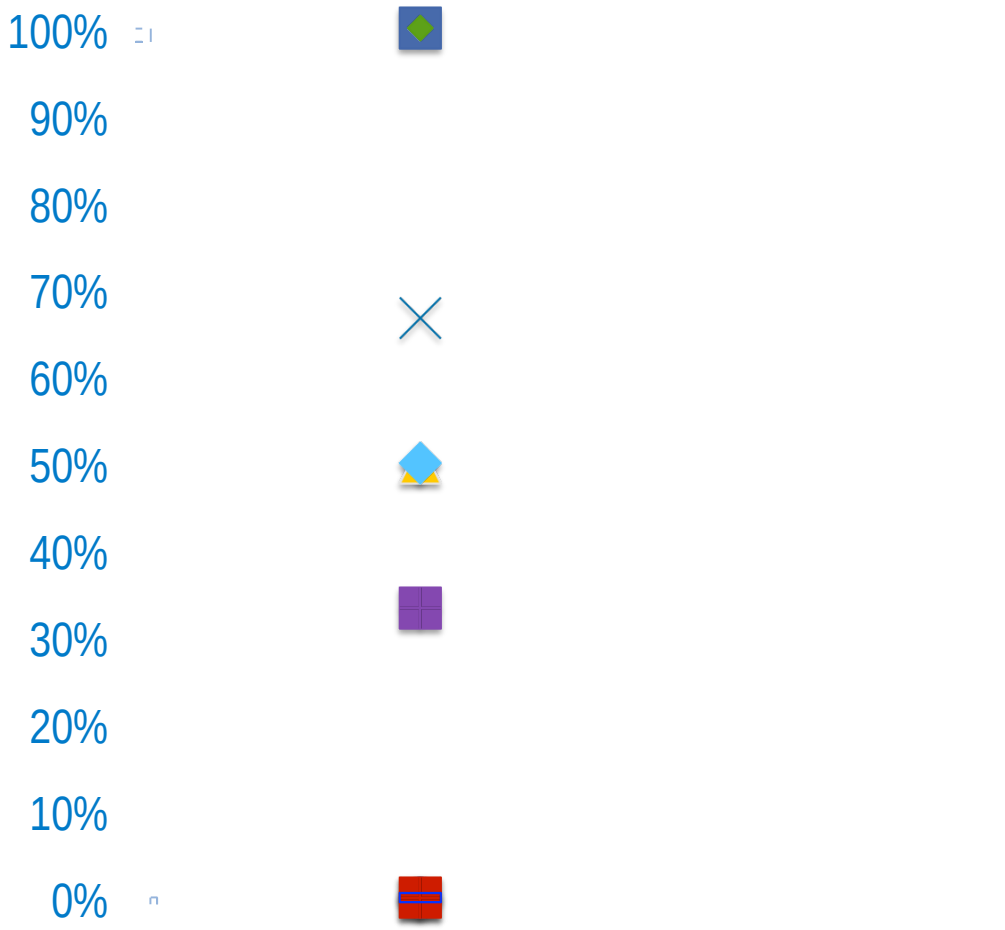
ECOLAB

Patient Room

Total % High Touch Objects Cleaned

N = 22

Current Period n = 22



ECOLAB®

Patient Room

% High Touch Objects Cleaned

N = 22

Current Period n = 22

	High Touch Object	Baseline	Q2 2011
PATIENT ROOM	Bed Rail/Controls	100%	
	Bedside Table Handle	100%	
	Call Button	50%	
	Chair	67%	
	IV Pole (Grab Area)	0%	
	Room Door Knob	0%	
	Room Light Switch	0%	
	Room Sink	0%	
	Telephone	33%	
	Tray Table	50%	
	Total Patient Room	41%	

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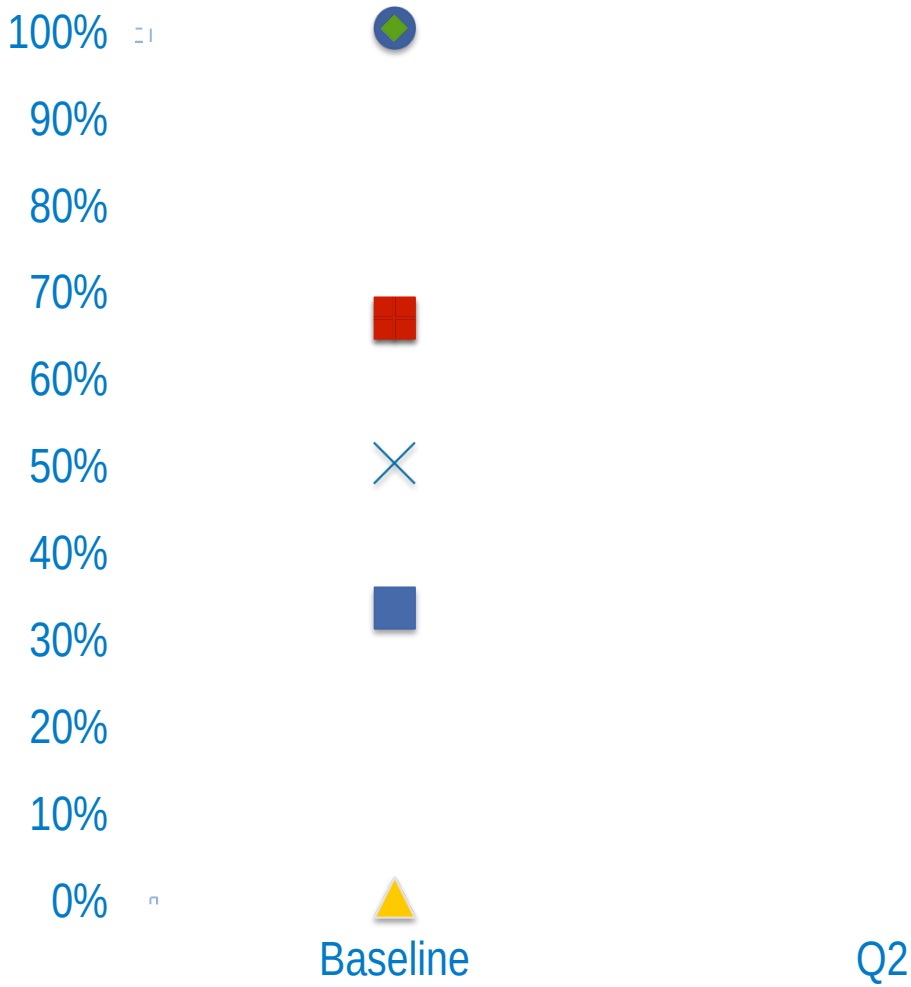
Patient Bathroom

% High Touch Objects Cleaned

N = 20

Current Period n = 20



ECOLAB®

Patient Bathroom

% High Touch Objects Cleaned

N= 20

Current Period n = 20

	High Touch Object	Baseline	Q2 2011
PATIENT BATHROOM	Bathroom Handrail by Toilet	**100%**	
	Bathroom Door Knob	**33%**	
	Bathroom Light Switch	**0%**	
	Bathroom Sink	**50%**	
	Toilet Bedpan Cleaner	**67%**	
	Toilet Flush Handle	**100%**	
	Toilet Seat	**67%**	
	Total Patient Bathroom	**60%**	

ECOLAB®

Room Level Baseline Results

Date	Unit	EVS Tech	Patient Room	Bathroom	Overall
Jul 08 2011	No Unit	Eve	56%	71%	63%
Jul 08 2011	No Unit	Eve	25%	71%	55%
Jul 08 2011	No Unit	eve	33%	33%	33%

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ENCOMPASS™ Environmental Hygiene Program

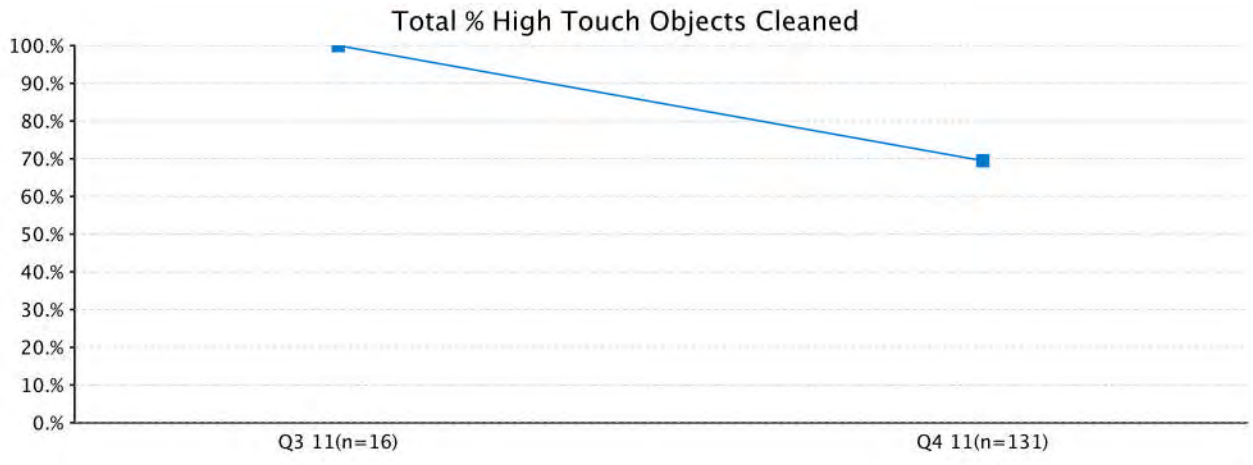
Dewitt Army Community Hospital

EnCompass™ Environmental Hygiene Results

ECOLAB

Report Run by User: dewitt39

Total % High Touch Objects



Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

Report Run by User: dewitt39

Focus Areas Report

Top 3 HTOs	% Cleaned
Tray Table	100 %
Toilet Seat	89 %
IV Pole	88 %

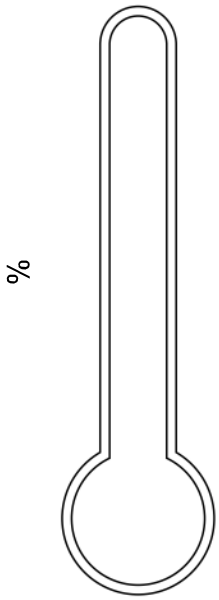
Bottom 3 HTOs	% Cleaned
Toilet Bedpan Cleaner	56 %
Call Button	56 %
Bed Rail/Controls	62 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

Report Run by User: dewitt39

Progress Against CDC Recommended Quarterly Sampling Current Quarter -- 04



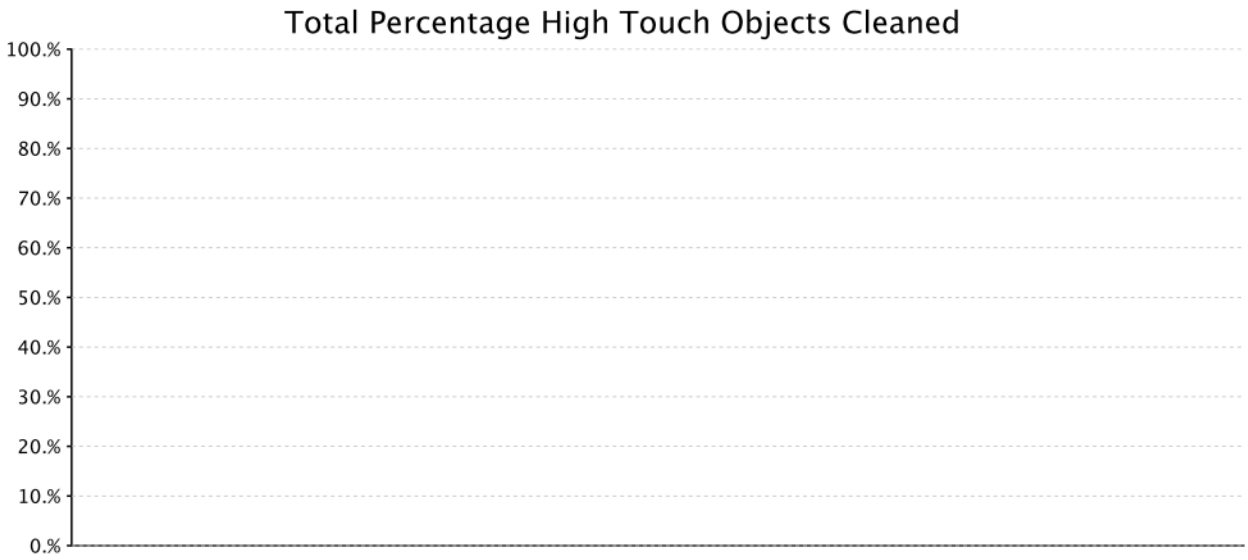
CDC Recommendation:	
Audits Completed:	8 rooms

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

Report Run by User: dewitt39

Patient Area Report

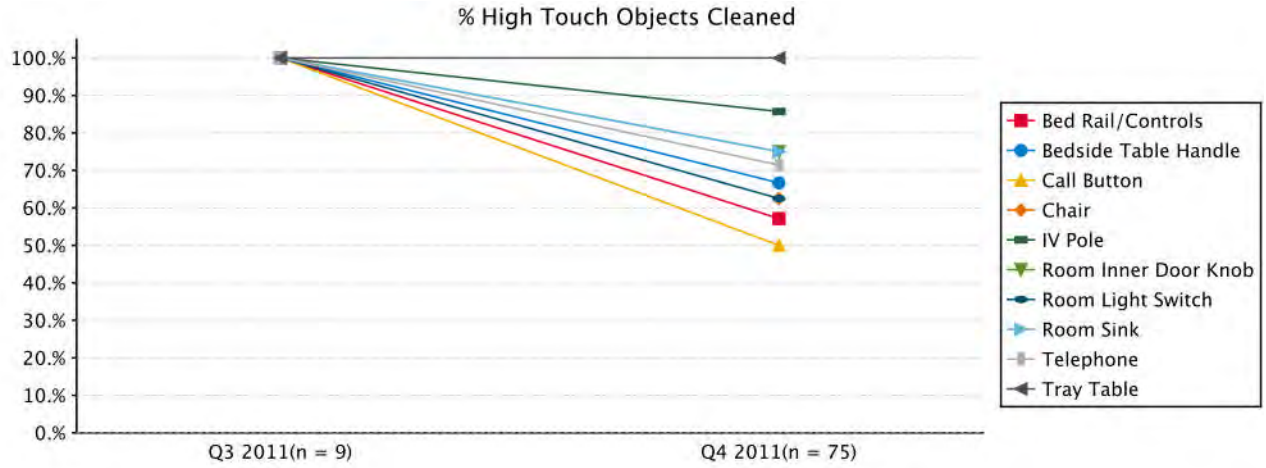


Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

Report Run by User: dewitt39

High Touch Object

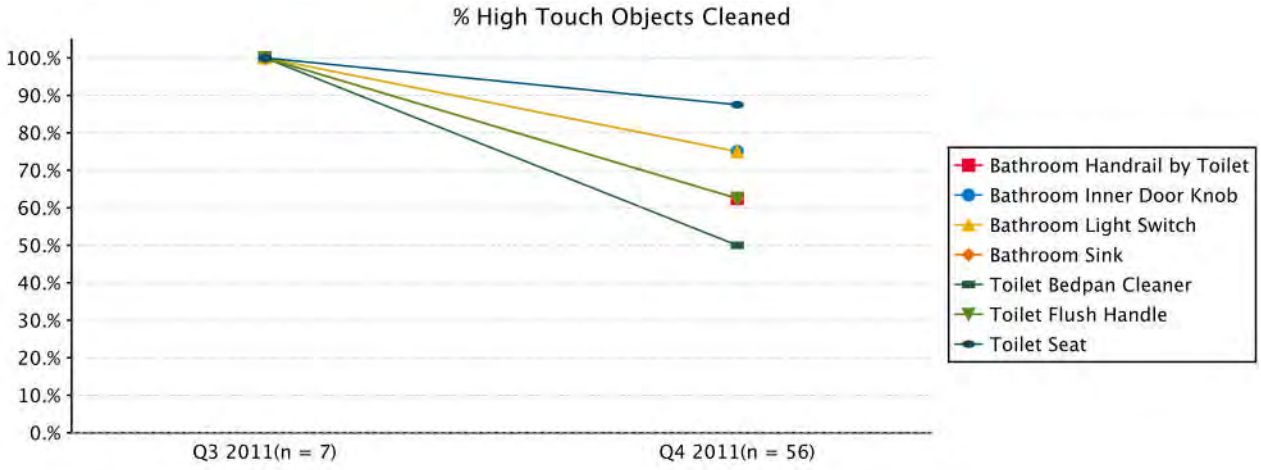


Quarter	Bed Rail/Contr	Bedside Table	Call Button	Chair	IV Pole	Room Inner Door	Room Light Switch	Room Sink	Telephone	Tray Table
Q3 2011	100 %	100 %	100 %		100 %	100 %	100 %	100 %	100 %	100 %
Q4 2011	57 %	67 %	50 %	62 %	86 %	75 %	62 %	75 %	71 %	100 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

Report Run by User: dewitt39



Quarter	Bathroom Handrail	Bathroom Inner Door	Bathroom Light	Bathroom Sink	Toilet Bedpan	Toilet Flush	Toilet Seat
Q3 2011	100 %	100 %	100 %	100 %	100 %	100 %	100 %
Q4 2011	62 %	75 %	75 %	62 %	50 %	62 %	88 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

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Percent High Touch Object Cleaned

High Touch Objects	Baseline	Q3 2011	Q4 2011	Net Improvement (Over Baseline)	Trend (Over Last Period)
Bed Rail/Controls		100 %	57 %	57 %	Down
Bedside Table Handle		100 %	67 %	67 %	Down
Call Button		100 %	50 %	50 %	Down
Chair			62 %	62 %	Up
IV Pole		100 %	86 %	86 %	Down
Room Inner Door Knob		100 %	75 %	75 %	Down
Room Light Switch		100 %	62 %	62 %	Down
Room Sink		100 %	75 %	75 %	Down
Telephone		100 %	71 %	71 %	Down
Tray Table		100 %	100 %	100 %	No Change
Bathroom Handrail by Toilet		100 %	62 %	62 %	Down
Bathroom Inner Door Knob		100 %	75 %	75 %	Down
Bathroom Light Switch		100 %	75 %	75 %	Down
Bathroom Sink		100 %	62 %	62 %	Down
Toilet Bedpan Cleaner		100 %	50 %	50 %	Down
Toilet Flush Handle		100 %	62 %	62 %	Down
Toilet Seat		100 %	88 %	88 %	Down
Total Patient Bathroom		100 %	68 %	68 %	Down
Total Patient Room		100 %	71 %	71 %	Down
Grand Total		100 %	69 %	69 %	Down
n=(# of objects evaluated)		16	131		

	< 70%
	70% - 80%
	> 80%

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

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Room Level Results

Date	Time	Unit	Room Number	EVS Tech	Patient Room	Bathroom	Overall
08/30/2011	11:14:56 (EDT)		07.334	Eve	100 %	100 %	100 %
10/12/2011	11:49:11 (EDT)		06.342	Eve	100 %	100 %	100 %
10/12/2011	12:52:01 (EDT)		02.122	Eve	67 %	0 %	38 %
10/12/2011	12:04:51 (EDT)		06.338	Eve	10 %	14 %	12 %
10/12/2011	13:38:30 (EDT)		06.244		78 %	86 %	81 %
10/12/2011	13:52:38 (EDT)		06.248 sw	Eve	100 %	100 %	100 %
10/13/2011	11:29:27 (EDT)		07.304		90 %	100 %	94 %
10/13/2011	11:43:47 (EDT)		07.328	Eve	100 %	100 %	100 %
10/13/2011	12:32:19 (EDT)		05.312	Eve	30 %	43 %	35 %

Include Baseline Results? yes, Dates between:2011-01-01 and 2011-10-20 Isolation Rooms?:All

ECOLAB

SampleID	TimeAcquired	SampleGroup	RoomNumber	Surface	Bacteria	BAPgrowth	MACgrowth
314	2011-08-24T15:10	Surgical Ward	5E06	COMPOSITE 1		YES	NO
318	2011-08-24T15:21	Surgical Ward	5E13	COMPOSITE 1		YES	NO
319	2011-08-24T15:16	Surgical Ward	5E08	COMPOSITE 1		YES	NO
323	2011-08-24T15:17	Surgical Ward	5E10	COMPOSITE 1		YES	YES
326	2011-08-24T15:20	Surgical Ward	5E11	COMPOSITE 1		YES	NO

BEFORE

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	ular Detection 1
343	2011-08-24T14:50	Bathroom door closer	YES	YES			
337	2011-08-24T14:51	Bathroom lightswitch	YES	NO			
339	2011-08-24T14:48	Bedpan cleaner	YES	YES			
344	2011-08-24T14:51	Bedside table	YES	YES			
333	2011-08-24T14:53	Call box	YES	NO			
340	2011-08-24T14:50	PT chair	NO	NO			
341	2011-08-24T14:54	Room door closer	YES	NO			
345	2011-08-24T14:51	Side rail	NO	NO			
335	2011-08-24T14:49	Sink top	YES	YES		Pseudom	
338	2011-08-24T14:52	Telephone	YES	NO			
336	2011-08-24T14:48	Toilet handle	NO	NO			
334	2011-08-24T14:49	Toilet rail	YES	NO			
342	2011-08-24T14:48	Toilet seat	NO	NO			
346	2011-08-24T14:52	Tray table	YES	YES			
347	2011-08-24T14:47	COMPOSITE 1	YES	YES			
348	2011-08-24T14:57	COMPOSITE 2	YES	YES			

AFTER

SampleID	meAcquire	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	ular Detection 1
369	2011-08-	Bathroom door closer	YES	NO			
376	2011-08-	Bathroom lightswitch	NO	NO			
379	2011-08-	Bedpan cleaner	NO	NO			
371	2011-08-	Bedside table	NO	NO			
366	2011-08-	Call box	NO	NO			
375	2011-08-	PT chair	YES	YES		Citrobacte	
367	2011-08-	Room door closer	YES	YES		Pantoea	
368	2011-08-	Side rail	NO	NO			
377	2011-08-	Sink top	YES	YES		Pseudom	
370	2011-08-	Telephone	YES	NO			
378	2011-08-	Toilet handle	YES	NO			
372	2011-08-	Toilet rail	YES	YES		Acinetoba	
373	2011-08-	Toilet seat	NO	NO			
374	2011-08-	Tray table	NO	NO			
380	2011-08-	COMPOSITE 1	YES	NO		Kocuria	
365	2011-08-	COMPOSITE 2	YES	YES		Pseudom	

BEFORE

SampleID	meAcquire	Surface	BAPgrowth	MACgrowth	16S	ulture ID 1	ular Detection 1
321	2011 08	Bathroom door closer	YES	YES		Stenotrop	
325	2011 08	Bathroom lightswitch	YES	NO		homonas	
329	2011 08	Bedpan cleaner	YES	NO		Staphyloc	
327	2011 08	Call box	NO	NO		occus	
331	2011 08	Room door closer	NO	NO			
328	2011 08	Sink top	YES	YES		Enterobac	
324	2011 08	Toilet handle	YES	NO		Staphyloc	
322	2011 08	Toilet rail	YES	YES		occus	
330	2011 08	Toilet seat	YES	YES		Enterobac	
317	2011 08	COMPOSITE 1	YES	YES		Enterobac	
332	2011 08	COMPOSITE 2	YES	NO		ter cloacae	

AFTER

SampleID	meAcquire	Surface	BAPgrowth	MACgrowth	16S	ulture ID 1	ular Detection 1
358	2011 08	Bathroom door closer	YES	NO		Micrococc	
362	2011 08	Bathroom lightswitch	YES	NO		us luteus	
352	2011 08	Bedpan cleaner	YES	NO		Staphyloc	
359	2011 08	Call box	YES	YES		occus	
363	2011 08	Room door closer	YES	NO			
356	2011 08	Sink top	YES	YES			
355	2011 08	Toilet handle	YES	NO			
360	2011 08	Toilet rail	YES	YES			
351	2011 08	Toilet seat	YES	NO			
349	2011 08	COMPOSITE 1	YES	YES			
364	2011 08	COMPOSITE 2	YES	YES		Citrobacte	
350	2011 08	Bedside table	NO	NO		r freundii	

BEFORE

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Molecular Detection 1
309	2011-08-24T14:01	Bathroom door closer	NO	NO			
303	2011-08-24T14:01	Bathroom lightswitch	YES	NO			
310	2011-08-24T14:00	Bedpan cleaner	YES	NO			
308	2011-08-24T14:02	Bedside table	NO	NO			
302	2011-08-24T14:03	Call box	YES	NO			
312	2011-08-24T14:07	Room door closer	YES	YES			
311	2011-08-24T14:02	Side rail	NO	NO			
305	2011-08-24T14:01	Sink top	YES	YES		Pseudomonas pseudoalcaligenes	
306	2011-08-24T14:02	Telephone	NO	NO			
313	2011-08-24T14:00	Toilet handle	YES	NO			
315	2011-08-24T14:00	Toilet rail	YES	NO			
304	2011-08-24T13:59	Toilet seat	NO	NO			
307	2011-08-24T14:03	Tray table	YES	YES			
301	2011-08-24T13:59	COMPOSITE 1	YES	YES		Pantoea agglomerans	
316	2011-08-24T14:09	COMPOSITE 2	YES	YES			

AFTER

SampleID	meAcquire	Surface	BAPgrowth	MACgrowth	16S	ulture ID 1	ular Detec
398	2011-08-25T14:03	Bathroom door closer	YES	NO			
392	2011-08-25T14:03	Bathroom lightswitch	YES	NO			
388	2011-08-25T14:03	Bedpan cleaner	YES	NO			
389	2011-08-25T14:03	Bedside table	YES	NO			
385	2011-08-25T14:03	Call box	YES	NO			
391	2011-08-25T14:03	Room door closer	YES	NO			
393	2011-08-25T14:03	Side rail	NO	NO			
384	2011-08-25T14:03	Sink top	YES	YES			
383	2011-08-25T14:03	Telephone	NO	NO			
395	2011-08-25T14:03	Toilet handle	NO	NO			
386	2011-08-25T14:03	Toilet rail	YES	YES			
399	2011-08-25T14:03	Toilet seat	NO	NO			
387	2011-08-25T14:03	Tray table	YES	NO			
396	2011-08-25T14:03	COMPOSITE 1	YES	NO			
320	2011-08-25T14:03	COMPOSITE 2	YES	NO			

tion 1

BEFORE

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Molecular Detection 1
219	2011-07-28T11:22	Bathroom door closer	NO	NO	-	-	-
227	2011-07-28T11:22	Bathroom lightswitch	NO	NO	-	-	-
229	2011-07-28T11:21	Bedpan cleaner	NO	NO	-	-	-
221	2011-07-28T11:23	Bedside table	YES	NO	+	-	-
224	2011-07-28T11:24	Call box	NO	NO	-	-	-
218	2011-07-28T11:25	PT chair	YES	YES	+	Shewanella putrefaciens	-
223	2011-07-28T11:26	Room door closer	YES	YES	+	Acinetobacter lwoffii	-
222	2011-07-28T11:23	Side rail	NO	NO	-	-	-
230	2011-07-28T11:22	Sink top	YES	NO	-	-	-
232	2011-07-28T11:20	Toilet handle	NO	NO	-	-	-
225	2011-07-28T11:21	Toilet rail	NO	NO	-	-	-
228	2011-07-28T11:18	Toilet seat	NO	NO	+	-	-
226	2011-07-28T11:24	Tray table	YES	NO	+	-	-
217	2011-07-28T11:18	COMPOSITE 1	YES	NO	+	-	-
220	2011-07-28T11:30	COMPOSITE 2	YES	NO	+	-	-

AFTER

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Molecular Detection 1
255	2011-07-29T10:27	Bathroom door closer	NO	NO	-	-	-
250	2011-07-29T10:27	Bathroom lightswitch	NO	NO	-	-	-
256	2011-07-29T10:26	Bedpan cleaner	NO	NO	-	-	-
261	2011-07-29T10:28	Bedside table	NO	NO	+	-	-
254	2011-07-29T10:28	Call box	NO	NO	-	-	-
252	2011-07-29T10:29	PT chair	YES	YES	+	Pseudomonas luteola	-
262	2011-07-29T10:29	Room door closer	YES	YES	+	Acinetobacter baumannii/calcoaceticus complex	Acinetobacter baumannii
263	2011-07-29T10:27	Side rail	NO	NO	-	-	-
258	2011-07-29T10:26	Sink top	YES	NO	-	-	-
253	2011-07-29T10:26	Toilet handle	NO	NO	-	-	-
259	2011-07-29T10:26	Toilet rail	NO	NO	+	-	-
251	2011-07-29T10:25	Toilet seat	NO	NO	-	-	-
260	2011-07-29T10:29	Tray table	YES	NO	+	-	-
249	2011-07-29T10:25	COMPOSITE 1	YES	YES	+	-	-
264	2011-07-29T10:31	COMPOSITE 2	YES	YES	+	Acinetobacter baumannii/calcoaceticus complex	-

BEFORE

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Culture ID 2	Culture ID 3	Molecular Detection 1	Molecular Detection 2
209	2011-07-28T10:45	Bathroom door closer	NO	NO	-					
207	2011-07-28T10:44	Bathroom lightswitch	YES	YES	+					
214	2011-07-28T10:43	Bedpan cleaner	NO	NO	-					
215	2011-07-28T10:46	Bedside table	NO	NO	-					
212	2011-07-28T10:47	Call box	NO	NO	-					
208	2011-07-28T10:49	PT chair	NO	NO	-					
211	2011-07-28T10:49	Room door closer	YES	YES	+	Stenotrophomonas maltophilia				
206	2011-07-28T10:46	Side rail	NO	NO	-					
210	2011-07-28T10:44	Sink top	YES	YES	+	Pseudomonas aeruginosa	Pseudomonas fluorescens	Serratia marcescens	Pseudomonas aeruginosa	
205	2011-07-28T10:47	Telephone	NO	NO	-					
203	2011-07-28T10:42	Toilet handle	YES	NO	+					
204	2011-07-28T10:43	Toilet rail	YES	NO	+					
202	2011-07-28T10:41	Toilet seat	NO	NO	-					
213	2011-07-28T10:48	Tray table	YES	YES	+	Acinetobacter lwoffii				
201	2011-07-28T10:40	COMPOSITE 1	YES	YES	+	Pseudomonas putida	Serratia marcescens			
216	2011-07-28T10:51	COMPOSITE 2	NO	NO	-					

AFTER

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Culture ID 2	Culture ID 3	Molecular Detection 1	ular Detec
238	2011-07-29T10:07	Bathroom door closer	YES	YES	+					
241	2011-07-29T10:06	Bathroom lightswitch	NO	NO	+					
242	2011-07-29T10:05	Bedpan cleaner	YES	NO	+					
237	2011-07-29T10:07	Bedside table	NO	NO	-					
240	2011-07-29T10:08	Call box	YES	NO	-	Enterococcus faecalis/faecium				
244	2011-07-29T10:08	PT chair	YES	YES	+					
236	2011-07-29T10:09	Room door closer	NO	NO	-					
239	2011-07-29T10:07	Side rail	NO	NO	-					
243	2011-07-29T10:06	Sink top	YES	YES	+	Pseudomonas putida				
247	2011-07-29T10:08	Telephone	NO	NO	+					
235	2011-07-29T10:05	Toilet handle	NO	NO	+					
246	2011-07-29T10:06	Toilet rail	YES	YES	+	Escherichia coli			Escherichia coli	
234	2011-07-29T10:05	Toilet seat	YES	YES	+	Escherichia coli			Escherichia coli	
245	2011-07-29T10:09	Tray table	YES	NO	+					
233	2011-07-29T10:05	COMPOSITE 1	YES	YES	+	Escherichia coli	Pseudomonas putida		Escherichia coli	
248	2011-07-29T10:14	COMPOSITE 2	YES	YES	+	Pseudomonas aeruginosa	Citrobacter freundii	Shewanella putrefaciens	Pseudomonas aeruginosa	

tion 2

BEFORE

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Molecular Detection 1	Molecular Detection 2
180	7-7	COMPOSITE 1	YES	NO	-	Klebsiella oxytoca		
100	2011-07-	Toilet seat	YES	NO	-			
101	2011-07-	Toilet handle	YES	YES	-			
102	2011-07-	Toilet rail	YES	YES	+	Pseudomonas putida		
103	2011-07-	Sink top	YES	YES	+			
104	2011-07-	Bathroom	NO	NO	-			
105	2011-07-	Bathroom door glass	NO	NO	-			
106	2011-07-	Side rail	NO	NO	-			
107	2011-07-	Bedside table	YES	NO	+			
108	2011-07-	Telephone	YES	NO	-			
109	2011-07-	Call box	NO	NO	-			
110	2011-07-	Tray table	YES	YES	+	Pantoea agglomerans		
111	2011-07-	Room door glass	NO	NO	-			
181	7-7	COMPOSITE 2	YES	YES	+		Acinetobacter baumannii	Clostridium difficile

AFTER

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Molecular Detection 1
188	40732	COMPOSITE 1	YES	NO	+	-	-

BEFORE

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Culture ID 2	Molecular Detection 1	Molecular Detection 2
117/118	2011-07-07T15:28	Bathroom door closer	YES	YES	+	Serratia marcescens	Acinetobacter baumannii/ calcoaceticus complex	Acinetobacter baumannii	Clostridium difficile
116	2011-07-07T15:24	Bathroom lightswitch	YES	YES	+	Serratia marcescens		Acinetobacter baumannii	Clostridium difficile
123	2011-07-07T15:33	Bedside table	YES	NO	+				
122	2011-07-07T15:31	Call box	YES	YES	+	Serratia marcescens		Acinetobacter baumannii	Clostridium difficile
124	2011-07-07T15:35	Room door closer	YES	YES	+				
119	2011-07-07T15:29	Side rail	NO	NO	-				
115	2011-07-07T15:23	Sink top	YES	YES	+	Serratia marcescens		Acinetobacter baumannii	Clostridium difficile
121	2011-07-07T15:30	Telephone	YES	YES	+	Acinetobacter baumannii		Acinetobacter baumannii	Clostridium difficile
113	2011-07-07T15:21	Toilet handle	YES	NO	+				
114	2011-07-07T15:22	Toilet rail	YES	NO	+				
112	2011-07-07T15:20	Toilet seat	YES	NO	+				
120	2011-07-07T15:30	Tray Table	YES	YES	+	Leclercia adecarboxylata			

AFTER

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Culture ID 2	Molecular Detection 1	Molecular Detection 2
173	2011-07-08T11:30	Bathroom door closer	YES	YES	+	Acinetobacter baumannii/calcoaceticus complex			
167	2011-07-08T11:29	Bathroom lightswitch	YES	YES	+	Acinetobacter baumannii/calcoaceticus complex		-	
168	2011-07-08T11:31	Bedside table	YES	NO	+			-	
176	2011-07-08T11:32	Call box	YES	YES	-	Acinetobacter baumannii/calcoaceticus complex		-	
174	2011-07-08T11:33	Room door closer	YES	NO	+			-	
171	2011-07-08T11:30	Side rail	NO	NO	-			-	
177	2011-07-08T11:28	Sink top	YES	YES	+	Klebsiella pneumoniae ssp ozaenae	Enterobacter cloacae	-	
172	2011-07-08T11:31	Telephone	YES	YES	+	Acinetobacter baumannii/calcoaceticus complex		-	
148	2011-07-08T11:27	Toilet handle	NO	NO	+			-	
170	2011-07-08T11:27	Toilet rail	YES	NO	+	Stenotrophomonas maltophilia		-	
156	2011-07-08T11:26	Toilet seat	YES	YES	+			-	
175	2011-07-08T11:32	Tray table	YES	YES	+	Stenotrophomonas maltophilia		-	
154	2011-07-08T11:28	Bedpan cleaner	NO	NO	-			-	
169	2011-07-08T11:33	PT chair	YES	YES	+	Acinetobacter baumannii/calcoaceticus complex	Pantoea agglomerans	-	
186	7-8	COMPOSITE 1	YES	NO	+	Acinetobacter baumannii/calcoaceticus complex		-	
187	7-8	COMPOSITE 2	YES	YES	+	Enterobacter cloacae	Citrobacter freundii	-	

BEFORE

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Molecular Detection 1
126	2011-07-07T15:59	Bathroom door closer	YES	YES	+	Alcaligenes faecalis	-
142	2011-07-07T16:00	Bathroom lightswitch	YES	NO	+		-
143	2011-07-07T15:59	Bedpan cleaner	YES	NO	+		-
134	2011-07-07T16:01	Bedside table	YES	NO	+	Moraxella species	-
125	2011-07-07T16:02	Call box	YES	NO	+		-
127	2011-07-07T16:00	Room door closer	YES	YES	+	Acinetobacter baumannii/calcoaceticus complex	-
133	2011-07-07T16:03	Side rail	YES	YES	+		-
141	2011-07-07T15:59	Sink top	YES	NO	+		-
129	2011-07-07T16:02	Telephone	YES	NO	+		-
137	2011-07-07T15:58	Toilet handle	NO	NO	-		-
139	2011-07-07T15:57	Toilet rail	YES	YES	+	Acinetobacter lwoffii	-
132	2011-07-07T15:56	Toilet seat	YES	NO	+		-
140	2011-07-07T16:02	Tray table	YES	NO	+	Staphylococcus haemolyticus	-

AFTER

SampleID	TimeAcquired	Surface	BAPgrowth	MACgrowth	16S	Culture ID 1	Molecular Detection 1
160	2011-07-08T11:07	Bathroom door closer	NO	NO	-		-
164	2011-07-08T11:06	Bathroom lightswitch	YES	NO	-		-
157	2011-07-08T11:05	Bedpan cleaner	NO	NO	-		-
147	2011-07-08T11:08	Bedside table	YES	NO	+	Staphylococcus haemolyticus	-
162	2011-07-08T11:09	Call box	YES	NO	+		-
153	2011-07-08T11:10	Room door closer	NO	NO	+		-
149	2011-07-08T11:07	Side rail	NO	NO	+		-
150	2011-07-08T11:06	Sink top	YES	YES	+	Acinetobacter baumannii	-
163	2011-07-08T11:08	Telephone	NO	NO	-		-
158	2011-07-08T11:04	Toilet handle	NO	NO	+		-
161	2011-07-08T11:05	Toilet rail	YES	NO	+		-
165	2011-07-08T11:03	Toilet seat	NO	NO	-		-
159	2011-07-08T11:09	Tray table	NO	NO	-		-
151	2011-07-08T11:10	PT chair	NO	NO	-		-
184	7-8	COMPOSITE 1	YES	YES	+		-
185	7-8	COMPOSITE 2	YES	NO	+		-